

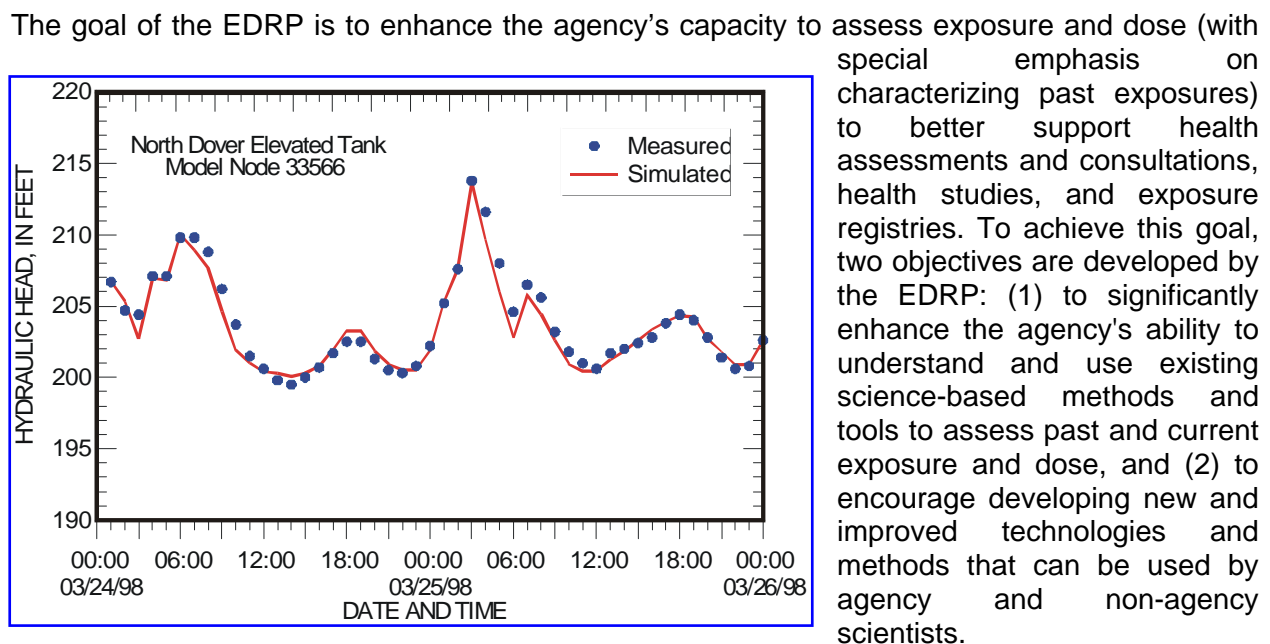
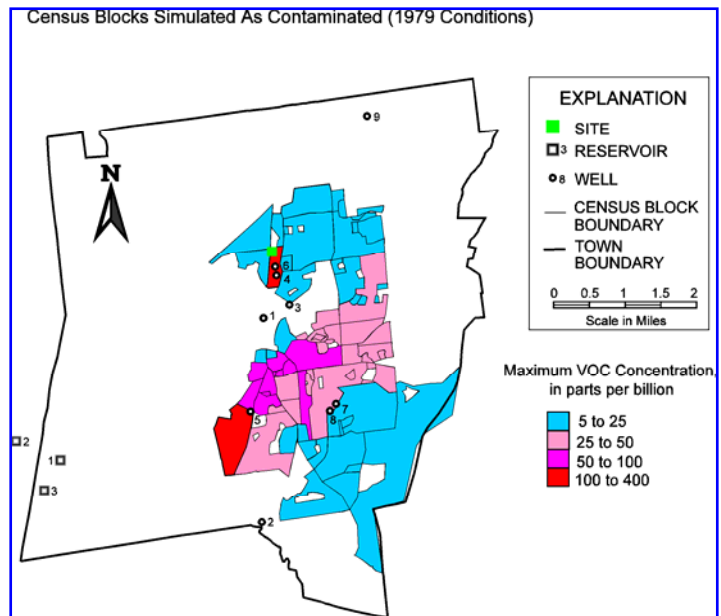
# ATSDR'S EXPOSURE-DOSE RECONSTRUCTION PROGRAM PROGRAM SUMMARY

## History

The Agency for Toxic Substances and Disease Registry (ATSDR), a U.S. Public Health Service agency, established the Exposure-Dose Reconstruction Program (EDRP) in March 1993. Because direct measures of exposure and dose, especially historical exposures, are often unavailable to health assessors and health scientists, the agency embarked on a coordinated, comprehensive effort to develop sensitive, integrated, science-based methods for exposure-dose characterization. The agency's EDRP coordinates relevant intramural and extramural projects covering environmental, geochemical, epidemiological, and biomedical disciplines.

## Goal and Objectives

For its purposes, ATSDR defines exposure-dose reconstruction as *an approach that uses computational models and other approximation techniques to estimate cumulative amounts of hazardous substances internalized by persons at presumed or actual risk from contact with substances associated with hazardous waste sites.* Although the emphasis of the program is on estimating past exposures, ATSDR also uses direct personal space and biologic sampling to determine current exposure levels. These direct exposure methods complement the EDRP.



The goal of the EDRP is to enhance the agency's capacity to assess exposure and dose (with special emphasis on characterizing past exposures) to better support health assessments and consultations, health studies, and exposure registries. To achieve this goal, two objectives are developed by the EDRP: (1) to significantly enhance the agency's ability to understand and use existing science-based methods and tools to assess past and current exposure and dose, and (2) to encourage developing new and improved technologies and methods that can be used by agency and non-agency scientists.

## Partners

Since its inception, the EDRP has applied the philosophy of agency capacity building and enhancement through partnerships with federal, state, and local government agencies, academic institutions, and private concerns. Examples of partners that the EDRP has cooperated with and, in some instances, funded are listed below:

- ATSDR, Division of Health Assessment and Consultation
- ATSDR, Division of Health Studies
- CDC, National Center for Environmental Health
- CDC, Office of the Director, Office of Health and Safety
- Environmental Protection Agency, Water Resources Division
- U.S. Geological Survey
- U.S. Department of Defense
- U.S. Marine Corps
- Massachusetts Department of Public Health
- New Jersey Department of Health and Senior Services
- Oregon Health Division
- State of Connecticut, Attorney General's Office
- Citizens Action Committee on Childhood Cancer Clusters
- Multimedia Environmental Simulations Laboratory, Georgia Institute of Technology



## Capability and Expertise

Through intramural and extramural funding, the EDRP assists ATSDR by enhancing the agency's capability in the areas of environmental health and exposure assessment. The EDRP draws on wide-ranging expertise for these analyses. Capabilities include:

Ground Water Model (Saturated) -- FileName: PCE\_01M.TWO

File Calculate! Results Units Monte Carlo Help

Two Dimensional	TITLE: Transport of PCE - North Avenue Railroad Plume Site,
Aquifer: Infinite	AUTHOR: Morris L. Maslia and Amy B. Funk
Contaminant: Gaussian	COMMENT: MONTE CARLO SIMULATIONS - PCE_01M - Source = 30

Coordinates Boundary Conditions Field and Chemical Constants

Ground Water Darcy Velocity (V)	Monte Carlo	ft/day
Longitudinal Dispersion Coefficient (Dx)	Monte Carlo	ft <sup>2</sup> /day
Lateral Dispersion Coefficient (Dy)	Monte Carlo	ft <sup>2</sup> /day
Contaminant Half-Life	1.e+6	day
Aquifer Porosity (n)	1	
Net Recharge (q)	9.1e-5	ft/day
Effective Aquifer Thickness (B)	200	ft
Retardation Coefficient (R)	Monte Carlo	

Monte Carlo

Please press Calculate before viewing the Results.

- Environmental fate and transport analyses
  - Groundwater
  - Surface water
  - Soil and air
- Water-distribution system analyses
  - Field-data collection and system monitoring
  - Model calibration and historical reconstruction of system operations
- Numerical analyses
  - Uncertainty analysis (Monte Carlo simulation, fuzzy math)
  - Genetic algorithm (GA) optimization
- Computational software and graphical user interface development
- GIS and spatial analysis technologies

## *Staff Qualifications*

The EDRP relies on agency staff uniquely qualified to conduct public health analyses and exposure assessment studies. The EDRP has conducted studies that range from technical assistance consultations to developing state-of-the-art computational analyses. Using extramural funding as a means of enhancing the EDRP capabilities, professional relationships have been developed with nationally and internationally recognized experts through the implementation and use of cooperative and interagency agreements. Through the use of intramural funding, the EDRP has supported a number of graduate-level students through the Oak Ridge Institute for Science and Education (ORISE), as well as other agency staff in the pursuit of advanced academic degrees. Below is a listing of staff associated with the EDRP. Some



staff have directly contributed to the success of the EDRP, while other staff have used the products and services of the agency's EDRP. Academic credentials and areas of expertise are also noted:

- Barbara A. Anderson, MSEnvE, P.E., ATSDR, Environmental Health Scientist, Environmental Science and fate and transport modeling
- Mustafa M. Aral, Ph.D., P.E., Georgia Institute of Technology — Fate and transport analysis, numerical methods
- Robert E. Faye, MSCE, P.E., Eastern Research Group, Inc., — hydrogeology and numerical modeling
- Walter M. Grayman, Ph.D., P.E., W.M. Grayman Consulting Engineer— Water-distribution systems
- Morris L. Maslia, MSCE, P.E., ATSDR — Project Officer, Environmental fate and transport
- Jason B. Sautner, MSCE, ATSDR, Environmental Health Scientist — Water resources management and numerical modeling
- Rene Suárez-Soto, MSCE, ATSDR, Environmental Health Scientist — Environmental science and numerical modeling

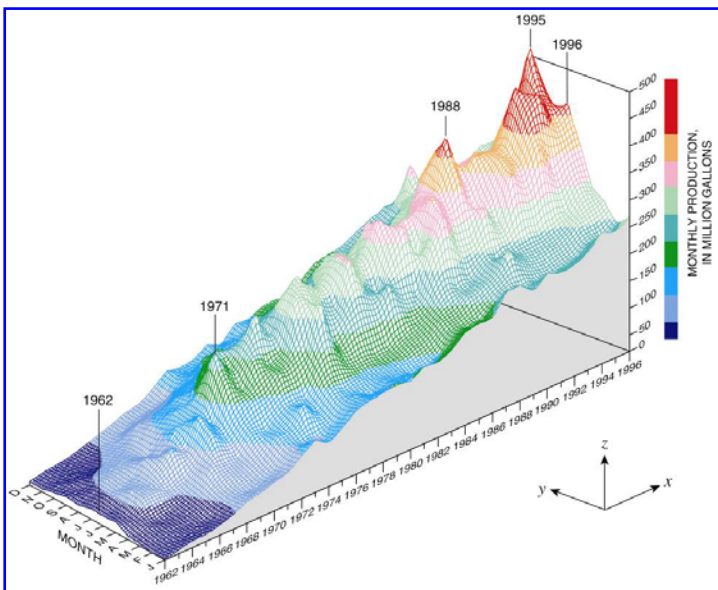


## *Examples of Research and Applications*

The EDRP conducts theoretical and applied research in areas of exposure assessment, environmental health, environmental fate and transport modeling, and numerical analysis. Additionally, EDRP staff develop workshops and present graduate-level courses at universities on the aforementioned areas of research. EDRP analyses have also been used and applied to numerous sites at which ATSDR is involved. Selected examples of EDRP research and applications include:



- Study of childhood birth defects and cancer at U.S. Marine Corps Base Camp Lejeune, NC
- Dover Township (Toms River), New Jersey, water-distribution modeling, support of epidemiologic investigation of childhood cancer
- Probabilistic analysis of pesticide transport at Oatland Island, Georgia
- Osborn Connecticut Correctional Institution, Somers, Connecticut—groundwater modeling, PCE contamination
- Solvents Recovery Services of New England, Southington, Connecticut—water-distribution system modeling, VOC contamination
- Newtown, Gainesville, Georgia—air dispersion modeling, arsenic contamination
- Brush Wellman, Elmore, Ohio—air dispersion modeling, beryllium contamination
- Exposure Investigations short course, ATSDR, March 1999
- Analytical contaminant transport analysis system software (ACTS) workshop, ATSDR, June 1999
- Quantitative exposure assessment, Autonomous University of San Luis Potosí, Mexico, May 2003
- Environmental and occupational hazards II (EOH 541), Emory University, January–May 2000, 2001, 2002



## Publications

The research conducted by the EDRP has been published in peer-reviewed internal and external publications. Some examples are listed below:

- Anderson, B.A., Maslia, M.L., Caparoso, J.L., and Ausdemore, D. Probabilistic Analysis of Pesticide Transport in Shallow Groundwater at the Oatland Island Education Center, Oatland Island, Georgia, Atlanta, GA: Agency for Toxic Substances and Disease Registry, 2007.
- Maslia, M.L., et al. Analyses of Groundwater Flow, Contaminant Fate and Transport, and Distribution of Drinking Water at Tarawa Terrace and Vicinity, U.S. Marine Corps Base Camp Lejeune, North Carolina: Historical Reconstruction and Present-Day Conditions—Chapter A: Summary of Findings. Atlanta, GA: Agency for Toxic Substances and Disease Registry, 2007.
- Grayman, W.M., Maslia, M.L., and Sautner, J.B. Calibrating Distribution System Models with Fire-Flow Tests. *Opflow, American Water Works Association*, 2006, v.32, no. 4, pp. 10–12.
- Guan, J., Aral, M.M., Maslia, M.L., and Grayman, W.M. Identification of contaminant sources in water distribution systems using simulation–optimization method: Case study. *ASCE Journal of Water Resources Planning and Management*, v. 132, no. 4, July/August 2006, pp. 252–262.



- Maslia, M.L., Reyes, J.J., Gillig, R.E., Sautner, J.B., Fagliano, J.A., and Aral, M.M. Public Health Partnerships Addressing Childhood Cancer Investigations: Case Study of Toms River, Dover Township, New Jersey, USA. *International Journal of Hygiene and Environmental Health*, 2005, v. 208, no. 1–2, pp. 45–54.
- Aral, M.M., Guan, J., Maslia, M.L., Sautner, J.B., Gillig, R.E., Reyes, J.J., and Williams, R.C. Optimal Reconstruction of Historical Water Supply to a Distribution System: B. Applications. *Journal of Water and Health*, 2004, v. 2, no. 3, pp. 137-156.
- Maslia, M.L., and Aral, M.M. ACTS—Analytical Contaminant Transport Analysis System (ACTS)—Multimedia Environmental Fate and Transport. *ASCE Practice Periodical of Hazardous, Toxic, and Radioactive Waste Management*, v. 8, no. 3, July 2004, pp.181-198.
- Maslia, M.L., Sautner, J.B., Aral, M.M., Gillig, R.E., Reyes, J.J., and Williams, R.C., 2001. Historical reconstruction of the water-distribution system serving the Dover Township area, New Jersey: January 1962-December 1996: Agency for Toxic Substances and Disease Registry (ATSDR), Atlanta, October 2001, 132 p.
- Aral, M.M., Guann, J., and Maslia, M.L., 2001. Identification of contaminant source location and release history in aquifers: *ASCE Journal of Hydrologic Engineering*, v. 6, no. 3, pp. 225-234.
- Maslia, M.L., Sautner, J.B., Aral, M.M. Abraham, J.E., Williams, R.C., and Reyes, J.J, 2000, Using water-distribution system modeling to assist epidemiologic investigations: *ASCE Journal of Water Resources Planning and Management*, v. 126, no. 4, July/August 2000, pp. 180-197.
- Aral, M.M., and Maslia, M.L., 1998, Multi-pathway environmental exposure assessment using ACTS and SAINTS software: Multimedia Environmental Simulation Laboratory report MESL-05-98, School of Civil and Environmental Engineering, Georgia Institute of Technology, October 1998, 78 p.
- Rodenbeck, S.E., and Maslia, M.L., 1998, Use of groundwater modeling and GIS to determine population exposure to trichloroethylene (TCE) at the Tucson International Airport area National Priorities List site, Tucson, Arizona, USA: *ASCE Practice Periodical of Hazardous, Toxic, and Radioactive Waste Management*, v.2, no. 2, pp. 53-61.
- Maslia, M.L., Aral, M.M., and Williams, R.C., 1997, Exposure assessment using analytical and numerical models: Case study: *ASCE Practice Periodical of Hazardous, Toxic, and Radioactive Waste Management*, v. 1, no. 2, pp. 50-60.
- Aral, M.M., Maslia, M.L., Ulirsch, and Reyes, J.J., 1996, Estimating exposure to VOCs from municipal water supply systems: Use of a better computational model: *Archives of Environmental Health*, v. 51, no. 4, pp. 300-309.

## Awards

The research conducted by the EDRP and its staff has been recognized for its excellence and contributions to the fields of environmental health and exposure assessment by being cited for scientific and literary awards. Listed below are several awards given to EDRP staff and its scientific publications:

U.S. Public Health Service Engineering Literary Award (Publications Category) for the publication: *Analytical Contaminant Transport Analysis System (ACTS)—Multimedia Environmental Fate and Transport*, June 2005

American Academy of Environmental Engineers, 2003 Excellence in Environmental Engineering Competition, Grand Prize, Research Category for “*Enhancing Environmental Engineering Science to Benefit Public Health*,” April 2003.

Assistant Administrator’s Award for Special Service to ATSDR, June 2002

Cummig Award, American Society of Military Engineers, 2000 to the Dover Township Water-Distribution System Modeling Team.

Environmental and Water Resources Research Institute of the American Society of Civil Engineers, Best Practice-Oriented Paper of 2000 for the paper, “*Using Water-Distribution System Modeling to Assist Epidemiologic Investigations*,” *ASCE Journal of Water Resources Planning and Management*, Vol. 126, July/August 2000.

Agency for Toxic Substances and Disease Registry, Science Award, 1998



U.S. Public Health Service Engineering Literary Award (Publications Category) for the publication: "*Exposure Assessment Using Analytical and Numerical Models: Case Study*," May 1998

U.S. Public Health Service Engineering Literary Award (Publications Category) for the publication: "*Estimating Exposure to VOCs from Municipal Water System Pipelines: Use and Application of a Computational Model*," May 1996

## Contact Information

For additional information on the EDRP or to obtain copies of its publications, contacts are listed below. Information and some publications are also available over the Internet.

Morris L. Maslia, MSCE, P.E., DEE  
Project Officer  
Agency for Toxic Substances and Disease  
Registry  
1600 Clifton Road, Mail Stop E-32  
Atlanta, Georgia 30333  
Phone: (404) 498-0415  
Fax: (404) 498-0069  
Email: [mmaslia@cdc.gov](mailto:mmaslia@cdc.gov)  
Web: <http://www.atsdr.cdc.gov>

Mustafa M. Aral, Ph.D., P.E.  
Director  
Multimedia Environmental Simulations Laboratory  
School of Civil and Environmental Engineering  
Georgia Institute of Technology  
Atlanta, Georgia 30332  
Phone: (404) 894-2243  
Fax: (404) 894-5111  
Email: [maral@ce.gatech.edu](mailto:maral@ce.gatech.edu)  
Web: <http://ce.gatech.edu/research/MESL>



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